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Evaluation of Advanced Clones for Reaction to Ringrot Infection

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Summary:

Twenty numbered clones and three named cultivars were tested in the field in the San Luis Valley for their reaction to inoculation with ringrot bacteria. The type and timing of symptom expression in the foliage and tubers was evaluated.

All clones and cultivars were susceptible to infection as evidenced by expression of symptoms in foliage and tubers and the presence of vascular exudate in the stems. Minimum time for recognizable symptoms to appear ranged from 50 to 92 days from planting. Percentages of inoculated plants which showed recognizable symptoms by mid August ranged from 5.6 to 80.0. By the time of the last reading, 101 days after planting, percentage of infection ranged from 5.6 to 85.0. Tubers from all clones showed symptoms by mid September but symptomatic tubers were few and difficult to find in at least one clone.

Methods and Materials:

Twenty advanced clones from the Colorado breeding program and three standard cultivars (Table 1) were tested for susceptibility to ringrot infection and symptom expression in field tests in the San Luis Valley. Tubers from each clone and cultivar were obtained from the San Luis Valley Research Center in April. The tubers were cut into seedpieces which weighed approximately 1.5 to 2.0 oz. Half of the cut seedpieces were inoculated with the ringrot organism, Clavibacter (Corynebacterium) sepedonicum, by dipping them into a slurry prepared by macerating infected tubers from the 1987 test plot in water using a food blender. The other half of the seedpieces were not inoculated and served as uninfected controls for comparison. The control (uninoculated) seedpieces for each clone and cultivar were prepared first and kept separate from the inoculated ones to avoid cross contamination with the ringrot bacterium. The inoculated and uninoculated seedpieces for each clone or cultivar were placed in individual paper bags, stored at about 5°C overnight, transported to the San Luis Valley the following day and planted in the field. The seedpieces were planted in randomized plots replicated three times on May 18, 1988. Each replicate plot consisted of 7 seedpieces planted 12 inches apart in the row. A 2 foot blank space was left between plots within the row and blank rows were left between planted rows across the plot to separate treatments and facilitate easy viewing of plants for symptom expression.

Uninoculated (control) seedpieces for all clones and cultivars were planted before the inoculated ones, again to avoid contamination of the controls.

Seedpieces were hand planted and covered mechanically.

Plots were furrow irrigated and weeds were controlled by hand pulling and hoeing as needed. Early blight and insects were controlled by fungicide and insecticide applications as necessary.

Plant emergence was recorded and plants were carefully examined at weekly intervals from emergence until readings were no longer possible due to maturity or other factors. Date of first symptom expression, number of plants in each plot which showed symptoms on each reading date, and types of symptoms expressed were recorded. At harvest, tubers were dug and examined to determine the symptoms present. The relative amount of tuber infection was determined by recording the ease with which infected tubers could be found based upon the number of replicates (1, 2 or 3) which had to be examined in order to find symptomatic tubers.

Results:

Data in Table 1 show that good stands were achieved with inoculated seed of all clones and cultivars except Sangre and CO8190-1 which produced stands of only 60-70%. Clones CO7918-11 and NDTX9-1068-11R both had marginal stands of about 76%. All other clones and cultivars produced stands of 80-100%. Earliest ringrot symptoms appeared 64 days after planting in Russet Burbank, Sangre and 11 of the 20 numbered clones tested. Centennial Russet and clones BC0038-1, CO7918-11, CO8138-6 and CO8195-4 showed first foliar symptoms at 76 days, 12 days later than they appeared in the earliest expressing clones or cultivars. One clone, BC0169-12 expressed symptoms 83 days after planting and two clones, AC77226-13 and CO8011-5 showed no symptoms until 92 days. This was 28 days later than the Russet Burbank standard.

Percentage of inoculated plants which showed recognizable symptoms by mid August, 92 days after planting, ranged from 5.6% to 80.0%. Very low percentages of symptomatic plants were found in clones CO8138-6 and CO7918-11. These clones showed only 5.6 and 6.3% symptomatic plants respectively as late as 101 days after planting. Clones AC77226-13, BC0038-1 and BC0169-12 had only 18-30% symptomatic plants at 92 days and percentages did not improve appreciably by 101 days. All other clones were comparable to or superior to Russet Burbank with regard to the percentage of symptomatic plants by mid August (92 days).

All clones and cultivars showed symptoms that were typical of bacterial ringrot. Symptoms in clones CO7918-11 and CO8138-6 were mild however.

Tubers produced by all clones and cultivars showed symptoms typical of bacterial ringrot on September 17. All tubers except those from clone CO7918-11 showed both external and internal symptoms of infection consisting of surface cracking, vascular discoloration and vascular exudates when the tubers were squeezed. Clone CO7918-11 showed only internal symptoms. No surface cracking was found.

Symptomatic tubers were easily found for most clones and cultivars by examining tubers from only one replication.

Table 1. Response of 23 clones and cultivars to inoculation with *Clavibacter* (*Corynebacterium*) *sepedonicum* in the San Luis Valley - 1988.

Clones or Cultivars	% Plants Emerged	Number of Days from Planting to First Symptoms	% Plants with Ringrot Symptoms 8/2	8/18	8/27	Symptoms Observed[1]
Russet Burbank	95.2	64	40.0	50.0	50.0	W,IVC,IVN,MN,SQ
Centennial Russet	95.2	76	5.0	30.0	30.0	ED,IVC,IVN,MN,SQ
Sangre	61.9	64	23.1	53.8	53.8	IVC,IVN,MN,SQ
WNC230-14	90.5	64	5.3	21.1	21.1	IVC,IVN,MN,SQ
A74212-1	81.0	64	11.8	41.2	41.2	IVC,IVN,MN,SQ
AC77226-13	76.2	92	0.0	18.8	37.5	IVC,IVN,MN,SQ
AC77101-1	90.5	64	36.8	73.7	73.7	IVC,IVN,MN,SQ
AC7869-17	85.7	64	38.9	61.1	61.1	W,ED,IVC,IVN,MN,SQ
AC79100-1	100.0	92	0.0	47.6	52.4	W,ED,IVC,IVN,MN,SQ
AC80369-1	95.2	64	80.0	80.0	85.0	W,IVC,IVN,MN,SQ
AC80545-1	100.0	64	23.8	42.9	42.9	W,IVC,IVN,MN,SQ
AC81198-11	81.0	64	23.5	70.6	76.5	IVC,IVN,MN,SQ
BC0024-3	100.0	64	52.4	61.9	66.7	W,IVC,IVN,MN,SQ
BC0038-1	100.0	76	9.5	23.8	23.8	W,IVC,IVN,MN,SQ
BC0169-12	95.2	83	0.0	30.0	30.0	ED,IVC,IVN,MN,SQ
C07918-11	76.2	76	6.3	6.3	6.3	IVC,IVN,MN,SQ
C08011-5	95.2	92	0.0	70.0	70.0	IVC,IVN,MN,SQ
C08138-6	85.7	76	5.6	5.6	5.6	W,IVC,IVN,MN,SQ
C08182-1	90.5	50	63.2	63.2	63.2	W,IVC,IVN,MN,SQ
C08190-1	71.4	64	53.3	73.3	86.7	W,IVC,IVN,MN,SQ
C08195-4	100.0	76	28.6	57.1	76.2	W,IVC,IVN,MN,SQ
C081103-1	95.2	64	55.0	65.0	70.0	W,ED,IVC,IVN,MN,SQ
NDTX9-1068-11R	76.2	64	12.5	50.0	50.0	W,ED,IVC,IVN,MN,SQ

[1]W = wilt, ED = early dwarfing, rosetting, IVC = interveinal chlorosis, IVN = interveinal necrosis, MN = marginal necrosis, SQ = vascular exudate.

Table 2. Tuber symptoms at harvest time resulting from inoculation of 23 clones and cultivars with Clavibacter (Corynebacterium) sepedonicum in the San Luis Valley, 1988

Clone or Cultivars	Tuber Symptoms Observed[1]	Number of Replications Examined Before Symptoms Were Detected
Russet Burbank	SC,VD,VS	1
Centennial Russet	SC,VD,VS	1
Sangre	SC,VD,VS	1
WNC230-14	SC,VD,VS	1
A74212-1	SC,VD,VS	1
AC77226-13	SC,VD,VS	2
AC77101-1	SC,VD,VS	1
AC7869-17	SC,VD,VS	1
AC79100-1	SC,VD,VS	1
AC80369-1	SC,VD,VS	1
AC80545-1	SC,VD,VS	1
AC81198-11	SC,VD,VS	1
BC0024-3	SC,VD,VS	2
BC0038-1	SC,VD,VS	1
BC0169-12	SC,VD,VS	1
CO7918-11	VD,VS	3
CO8011-5	SC,VD,VS	1
CO8138-6	SC,VD,VS	2
CO8182-1	SC,VD,VS	1
CO8190-1	SC,VD,VS	1
CO8195-4	SC,VD,VS	2
CO81103-1	SC,VD,VS	1
NDTX9-1068-11R	SC,VD,VS	1

[1]SC = surface cracking, VD = vascular discoloration, VS = vascular exudate when squeezed.

However, in the case of four clones, AC77226-13, BC0024-3, CO8138-6 and CO8195-4 tubers in two replications had to be checked before tubers showing the whole range of typical symptoms were found. In the case of clone CO7918-11 tubers in all three replications were carefully examined and only a few tubers with internal symptoms were found. No surface cracking was found on tubers of this clone in any of the replications.

Discussion:

Generally, most of the clones tested in 1988 reacted to inoculation with the ringrot organism in a way which would make them good candidates for production as new cultivars. They expressed typical foliar and tuber symptoms as early as the standard cultivars included in the test and the percentages of inoculated plants which showed recognizable symptoms was equivalent to or higher than the standard cultivars.

Some clones, however, reacted in such a way that they may be potential problems in commercial seed production. Clones CO7918-11 and CO8138-6 are particularly worrisome because of the very small percentage of plants which showed detectable foliar symptoms by the end of the growing season. These clones showed symptoms in only 5-7% of the inoculated plants compared to 50-54% in Sangre and Russet Burbank and 21% in WNC230-14 which is considered to be a poor expressor of ringrot symptoms in the San Luis Valley. This characteristic in these clones is of particular concern since 1988 was an unusually favorable year for ringrot symptom expression. Symptoms were observed in one cultivar which had shown no symptoms in the two previous years. Symptoms were also found in cultivars inoculated with bacterial numbers which had not previously produced visible symptoms in the San Luis Valley. Clone CO7918-11 has the additional disadvantage of showing weak tuber symptoms in only a small percentage of tubers.

Some other clones should be considered very carefully before being considered for release as new cultivars. Some of these showed symptoms considerably later than the standard cultivars. Clones AC79100-1, CO8011-5 and AC77226-13 expressed no symptoms until 92 days after planting compared to 64 days for both Sangre and Russet Burbank. In a more typical year in the San Luis Valley symptom expression might be late enough to create problems for visual detection by field inspectors. Besides expressing symptoms relatively late, clone AC77226-13 also showed symptoms in only 19% of the inoculated plants by mid August compared to 54% in Sangre and 50% in Russet Burbank.

A third group of clones, including BC0038-1 and BC0169-12, also bear watching since they expressed initial symptoms later than Russet Burbank and Sangre (but earlier than AC77226-13, AC79100-1 and CO8011-5) and showed visible symptoms in relatively low percentages (24-30%) of inoculated plants when compared with Sangre and Russet Burbank.

It seems logical to group clones CO7918-11, CO8138-6, AC79100-1, CO8011-5 and AC77226-13 into a potentially highly dangerous group with regard to ringrot reaction based upon lateness of symptom expression and the small percentage of inoculated plants which express symptoms. Clones BC0038-1 and BC0169-12 should probably be grouped into a moderately dangerous group based upon their somewhat

later disease expression and the reduced percentages of plants which show symptoms compared to the good expressors, Sangre and Russet Burbank. This group of clones are similar to WNC230-14 and Centennial Russet with regard to ringrot expression.

Based upon these data, all other clones would be considered as showing characteristics suggesting that they would not create problems for ringrot detection in a certification program.